



**Department of  
Environmental Protection  
Bureau of Land & Water Quality September 2003**

**O&M Newsletter**

A monthly newsletter for wastewater discharge licensees, treatment facility operators, and associated persons

## **Quality Assurance**

Quality Assurance is a set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and defensible quality. A quality assurance plan should include the following: cover sheet with plan approval signatures, staff organization and responsibilities, quality assurance objectives and activities, sample collection procedures, sample control and documentation procedures, laboratory water quality, standard operating procedures for each analytical method (SOP), analyst training requirements, reagent/standard quality preparation and traceability, equipment preventative maintenance procedures, calibration procedures, corrective actions, internal quality control activities, performance audits, data assessment procedures for bias and precision, and data reduction, validation and reporting.

Lab bench sheets must be maintained that document when the sample was collected, how it was preserved, all of the calculations, and what results were obtained.

## **Quality Control**

A good quality control program consist of at least seven elements: certification of analyst competence, recovery of known additions, analysis of externally supplied standards, analysis of reagent blanks, calibration with standards, analysis of duplicates and maintenance of control charts.

Quality Control includes testing which is done to prove that the results are reliable. One of every ten samples should be a Quality Control check. This may include duplicate samples, spike samples, reagent blank analysis and known QC samples obtained from outside sources.

Duplicate sample analysis involves analyzing the same sample two or more times and comparing the results. The closer the results, the more accurate the analysis. Results should not differ by more than 10%. Spiked sample analysis involves adding known amounts of analyte to a sample and calculating the percent recovery.

## **Quality Assessment**

Quality Assessment is the process of using external and internal quality control measures to determine the quality of the data produced by the laboratory. It includes such items as performance evaluation samples, laboratory intercomparison, and performance audits.

As a first step for quality assurance in sample collection the sampling program should delineate the details on sampling locations, sample type, sample frequency, number of samples, duration of sampling, sample volume, sample collection methods, equipment to be used for the sample collection, sample containers, pretreatment of containers, type and amount of preservative to be used, blanks, duplicates, spiked samples, replicates, chain of custody procedures, and any other pertinent matter which will have a bearing on the quality assurance in sample collection and handling.

As a second step for quality assurance, procedures should be developed for routine testing, maintenance and calibration of the equipment. Manufacturer's instructions are appropriate guides on these procedures. These procedures should establish routine maintenance, testing and calibration intervals, set up written procedures for maintenance, testing and calibration, list the required calibration standards, determine the environmental conditions requiring calibration, and generate a documentation record system. Equipment should be labeled to indicate the calibration data and when the calibration or maintenance expires.

As a third step in quality assurance, random control checks should be performed to make sure that appropriate sampling guidelines on sample collection, handling and chain of custody are followed by the field personnel; and deviations, if any, are rectified. Analytical quality control as an aid to quality assurance can be performed through duplicate, split, and spiked samples; sample preservation blanks, precision, accuracy and control charts.

## **Reagent Quality**

Reagents are the chemicals, liquid and solid, used in the laboratory.

- a) Reagents usually display an expiration date on the box or bottle. Expired reagents should not be used. Shelf lives and expiration dates can be obtained from the manufacturer or supplier if they are not displayed.
- b) Date reagents are received and opened must be recorded on the box or bottle. This can be helpful should trouble-shooting become necessary.
- c) Order chemicals for which the American Chemical Society has published specifications in the "ACS grade". If unavailable order chemicals as "analytical reagent grade".

Parameter	Calibration/ Standardization	QC Standards	Duplicates/ Replicates	Spikes	Blanks
Ammonia	As per method	1/10 Tests	1/10 Tests	1/Yr	1/each
BOD	Meter before each use	1/10 Test IGGA/Each if seeded	1/10 Tests	1/Yr	1/each
Chlorine Residual Meter	Check standard curve daily standard for each use	1/month	1/10 Test	1/Yr	1/each
Titrimetric	FAS stand 1/month	1/month	1/10 Test	1/Yr	1/each
COD	As per method	1/10 Test	1/10 Test	1/Yr	1/each
Cyanide	As per method	1/each	1/each	1/each	1/each
E. Coli	Additional QC required for E. Coli includes equipment sterility checks (indicator tape, “Kilit” ampules) each tests and pH check of dilution water ( $7 > 1 \pm .2$ ) each test	2/Yr /POS control/each test	1/each	N/A	1/each
Metals	As per method	1/each	1/each	1/each	1/each
Nitrate Nitrogen	As per method	1/10 Tests	1/10 Tests	1/Yr	1/each
Oil & Grease	As per method	1/each	1/each	1/Yr	1/each
pH	Minimum 2 point calibration each use	(3 <sup>rd</sup> buffer) 1/each	1/10 Tests	N/A	N/A
Phosphorus	5 Standards/each	1/10 Tests	1/10 Tests	1/Yr	1/each
Settleable Solids	N/A	N/A	1/10 Tests	N/A	N/A
Total Suspended Solids	Constant weights before and after filtering sample	1/10 Tests	1/each	N/A	1/each

### Type of Sample and Holding Time

Parameter	Type of Sample	Holding Time	Sample Container	Location
pH	Grab	15 Minutes	Plastic Bottle	Refer to Diagram
Temperature	Grab	At Site	Plastic Bottle	Refer to Diagram
Dissolved Oxygen	Grab	15 minutes	BOD Bottle	Refer to Diagram
BOD	Composite Flow Proportional	6 Hours	Composite Sampler Plastic Bottles	Refer to Diagram
Total Coliform Fecal Coliform E. Coli	Grab	1 Hour	Sterile Sample Plastic Bottle W/Sodium Thiosulfate	Refer to Diagram
Chlorine Residual	Grab	15 Minutes	Opaque BOD Glass Bottle	Refer to Diagram
Total Suspended Solids	Composite Flow Proportional	6 Hours	Composite Sampler Plastic Bottles	Refer to Diagram
Specific Conductance	Grab	15 Minutes	Glass	Refer to Diagram
Metals	Grab/ Composite	6 Months	Amber Glass	Refer to Diagram
TKN	Grab	1 Hour	Plastic Bottle	Refer to Diagram
Settleable Solids	Grab	30 Minutes	Plastic Bottle	Refer to Diagram

## Preservation Conditions

Parameter	Container	Volume	Preservation	Holding Time	Representative Sampling Time
BOD, TSS	P	1 L	4°C	24 Hours	8 AM – 8 AM
TKN	P	.5 L	H <sub>2</sub> SO <sub>4</sub> pH < 2.0 4°C	28 Days	8 AM – 8 AM
Oils & Grease	G	1 L	HCl pH < 2.0	24 Hours	Between 8 AM and 12 PM
Metals	GA	.2 L	HNO <sub>3</sub> pH < 2.0	6 Months	8 AM – 8 AM
Phenols	G	.5 L	H <sub>3</sub> PO <sub>4</sub> pH < 2.0 + 1t CuSO <sub>4</sub> 4°C	24 Hours	8 AM – 8 AM
Cyanides (T)	P	1 L	NaOH pH > 12.0 4°C	24 Hours	2 PM
VOC	V	40 ml	4°C	24 Hours	2 PM

G = Glass bottle with Teflon lined lid

GA = Amber bottle with Teflon lined lid

P = Plastic Bottle

V = Approved glass vials with Teflon and pure rubber seals

Note: All samples are refrigerated at 4°C after preservation.

## TSS

Annually check the balance by a service representative. Monthly check calibration with 2 S class weights (1 g , 10 mg). The oven temperatures are closely monitored. Duplicate samples should be run on every tenth sample. The facility should participate in the annual EPA DMR-QA Study.

## pH

In pH testing, buffers must be checked daily and duplicate samples should be run on every tenth sample. Buffers are NIST Traceable, are changed daily and recorded. The facility should participate in the annual EPA DMR-QA Study.

## DO

Calibrate DO meters after 15-minute probe warm-up using the saturated air method. Check for air bubbles under the probe membrane and fouled membranes. Calibrate with a barometric pressure correction factor. Let meter reading stabilize before recording the DO

## **BOD**

In BOD testing, dilution water blanks must be run with each group of samples and should not show a depletion of more than 0.2 mg/L DO. Duplicate samples should be analyzed to test for variability on every tenth sample. A glucose-glutamic acid solution should be made by dissolving 150 mg each of oven-dried glucose and glutamic acid in 1 L of distilled water. Six ml of this solution in a 300 ml BOD bottle should yield  $200 \pm 37$  mg/L after five days incubation at 20°C. BOD standards may also be purchased. The glucose-glutamic acid dilutions must be seeded since the solution does not contain any microorganisms. The recommended control limit for BOD is one standard deviation. In establishing its control limit, it is recommended that initially each laboratory performs a minimum of 25 glucose-glutamic acid check over a period of several weeks or months and calculates the mean and the standard deviation. Once the control limits for this test are completed, then each laboratory should perform a minimum of 1 glucose-glutamic acid check every ten samples. The facility should participate in the annual EPA DMR-QA Study.

## **TRC**

In residual chlorine testing, duplicate samples should be run every tenth sample to test for variability. If using DPD, a colorimeter or spectrophotometer must be used. Compararator methods are unacceptable. The facility should participate in the annual EPA Quality Control Study. The recommended control limit for Total Chlorine Residual is one standard deviation. In establishing its control limits, it is recommended that initially each laboratory perform a minimum of 25 total residual chlorine measurements of standards over a period of several weeks or months and calculate the mean and the standard deviation.

## **Fecal Coliform/E.coli**

Duplicate samples should be run every tenth sample to test for variability. A sterility check and growth check should be run on the MFC broth each time a new batch is made. The sterility check proves that the broth is not contaminated with fecal coliforms and is performing by placing broth on a filter pad in the culture dish without any sample. There should be no growth after 24 hours of incubation. The growth check proves the MFC broth is capable of sustaining colonies and is performed by filtering several milliliters of plant influent through a filter. Colonies should form after incubating for 24 hours. Pre and Post filtration blanks should be done on every sample run.

## **Laboratory Bench Sheets**

The plant operator has two goals in using a laboratory notebook and bench sheets: first to record data, and second, to arrange the data in an orderly manner. The standardized bench sheet facilitates the calculation of laboratory results in a uniform manner. This is a good way to achieve greater consistency between analyst.

## Quality Control Work Sheets/Log books

Each laboratory is also required to document proper care of equipment and handling of lab chemicals. An equipment maintenance sheet should be kept up to date reporting all maintenance performed on lab instruments. The sheet should include the date, time and technician who performed the work. Repairs to equipment, changed membranes, cleanings, preventative maintenance checks and observed problems should be recorded.

Every refrigerator, oven, water bath and incubator must have a temperature recorded on a daily basis of both the target temperature and the actual temperature achieved by the device.

A chemical inventory must be maintained that documents date of purchase, expiration date, date of opening, and data when the chemical is used up or discarded. It is also helpful to record where the chemicals were purchased. The Chemical ID Law requires a full set of MSDS sheets for every chemical on site. The lab needs MSDS forms for lab chemicals.

A reagent preparation log must be maintained for analysts to record the date of preparation of standards and reagents. This helps to maintain control over reagent preparation and provides a method to trace the source of error when problems are encountered. New standardization curves should be produced on a periodic basis for all spectrophotometer analytes.

## Significant Digits

Parameter	Significant Digits
BOD – No digit after decimal point	28 mg/L
Chlorine Residual – Two digits after decimal point	0.51 mg/L
Coliform – No digits after decimal point	50/100 ml
TKN, NH <sub>3</sub> , NO <sub>3</sub> – One digit after decimal point	17.6 mg/L
DO – Two digits after decimal point	7.35 mg/L
Settleable Solids – One digit after decimal point	5.1 ml/L
Metals – One digit after decimal point	436.3 ppb
pH – Two digits after decimal point	7.00 pH units
Suspended Solids – No digit after decimal point	22 mg/L
Temperature – One digit after decimal point	17.2°C

## Rounding

All digits are used in calculation, than are rounded, using the following guidelines. Numbers that are not significant must be dropped by rounding off. If the digit 5, 6, 7, 8, 9 is dropped round up one unit. If the digit 0, 1, 2, 3, 4 is dropped, do not change the preceding digit.

For example:

3.57 is rounded to 3.6

2.41 is rounded to 2.4

7.55 is rounded to 7.6

7.44 is rounded to 7.4

For Certification Information Contact:

- ? NEWEA Voluntary Wastewater Laboratory Certification Exam (781)939-0908
- ? NELAC (919)541-1039
- ? HETL (207)287-2727

For Additional Laboratory Management Information Contact:

- ? Don Albert, Manager, Compliance and Technical Assistance Unit, (207)287-7767
- ? Ken Jones, Technical Assistance, (207)287-4869
- ? Stuart Rose, Portland Regional Office Supervisor, (207)822-6345
- ? Beth DeHaas, Augusta Regional Office Supervisor, (207)287-4860
- ? James Sohns, Bangor Regional Office Supervisor, (207)941-4571
- ? Bill Sheehan, Presque Isle Regional Office Supervisor, (207)764-0477

## **Approved Training**

September 10, 2003 in Topsham, ME –  
Applied Hydraulics – Sponsored by  
MRWA, (207) 729-6569 – Approved for 4  
hours.

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September 25, 2003 in Portland, ME – Bulk  
Chemical Delivery Workshop- Sponsored  
by MWUA/NEWWA (508) 893-7979 –  
Approved for 6 hours.

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September 23, 2003 in Brewer, ME –  
Improving Water Quality: Phosphorous  
Removal – Sponsored by MRWA, (207)  
729-6569 – Approved for 6 hours.

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September 25, 2003 in Topsham, ME –  
Applied Disinfection – Sponsored by  
MRWA, (207) 729-6569 – Approved for 4  
hours.

October 1, 2003 in Bangor, ME – Cross  
Connection Control – Sponsored by  
MRWA, (207) 729-6569 – Approved for 3.5  
hours.

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October 2, 2003 in Topsham, ME – Cross  
Connection Control – Sponsored by  
MRWA, (207) 729-6569 – Approved for 3.5  
hours.

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October 2, 2003 in Topsham, ME – Cross  
Connection Control – Sponsored by  
MRWA, (207) 729-6569 – Approved for 3.5  
hours.

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October 2, 2003 in Augusta, ME (Togus) –  
Electrical Safety – Sponsored by MRWA,  
(207) 729-6569 – Approved for 4 hours.

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October 7 & 8, 2003 in Portland, ME –  
Basic Microbiology & Filamentous Bacteria  
Identification – Sponsored by  
JETCC/NEIWPC, (207) 253-8020 –  
Approved for 12 hours.

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October 16, 2003 in Waterville, ME –  
Advanced Excel Spreadsheets with Tips for  
Managing e-mail – Sponsored by JETCC,  
(207) 253-8020 – Approved for 6 hours.

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October 21, 2003 in Mexico, ME –  
Excavation: Competent Person Training –  
Sponsored by MRWA, (207) 729-6569 –  
Approved for 5 hours.

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October 22, 2003 in Boothbay, ME –  
Excavation: Competent Person Training –  
Sponsored by MRWA, (207) 729-6569 –  
Approved for 5 hours.

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October 23, 2003 in Livermore Falls, ME –  
pipe maintenance for Clay & Root  
Infiltration – Sponsored by JETCC, (207)  
253-8020 – Approved for 6 hours.

October 30, 2003 in Presque Isle, ME –  
BOD, Seeded BOD. E-Coli, Solids &  
Microscopic Examination - Sponsored by  
JETCC, (207) 253-8020 – Approved for 6  
hours.

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October 30, 2003 in Presque Isle, ME –  
Solids Handling, Utility Mgmt &  
Disinfection – Sponsored by MRWA, (207)  
729-6569 – Approved for 6 hours.

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November 5, 2003 in Brunswick, ME –  
Centrifugal Pump Hydraulic Application &  
Troubleshooting - Sponsored by JETCC,  
(207) 253-8020 – Approved for 6 hours.

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November 6, 2003 in Portland, ME – New  
Technologies in Phosphorous Removal -  
Sponsored by JETCC, (207) 253-8020 –  
Approved for 6 hours.

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November 6, 2003 in Brunswick Isle, ME –  
Solids Handling, Utility Mgmt &  
Disinfection – Sponsored by MRWA, (207)  
729-6569 – Approved for 6 hours.

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November 13, 2003 in Augusta, ME –  
Caring for you lab instruments, Establishing  
a Lab QA/QC Program & proper Sampling  
Techniques - Sponsored by JETCC, (207)  
253-8020 – Approved for 6 hours.

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November 19, 2003 in Norway, ME –  
Excavation: Competent Person Training –  
Sponsored by MRWA, (207) 729-6569 –  
Approved for 5 hours.

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November 20, 2003 in South Portland, ME –  
SCADA System Management &  
Maintenance - Sponsored by JETCC, (207)  
253-8020 – Approved for 6 hours.

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December 9, 2003 in Presque Isle, ME –  
Safety/Security Screening of wastewater for  
toxicity & Simplifying your Wastewater  
Process Monitoring - Sponsored by JETCC,  
(207) 253-8020 – Approved for 6 hours.

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December 11, 2003 in Augusta, ME – 10  
Best Kept Water & Wastewater  
Management Secrets with Simplified  
Nutrient Monitoring in Small Wastewater  
Systems - Sponsored by JETCC, (207) 253-  
8020 – Approved for 6 hours.

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December 12, 2003 in Augusta, ME –  
Chlorination Disinfection Science:  
Comparing Gas, Liquid and Powder  
Chlorination Process plus 10 Best Kept  
Water & Wastewater Management Secrets -  
Sponsored by JETCC, (207) 253-8020 –  
Approved for 6 hours.

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December 2&3, 2003 in Freeport, ME -  
MRWA Annual Conference – Sponsored by  
MRWA, (207) 729-6569 – Approved for  
TBA hours.

### ***For Practice:***

Like the “Car Talk Puzzler”, the “For Practice” section of the *O&M News* took a vacation last month. To make up for the absence, we’ve doubled the size of the “For Practice” section this month.

1. The thickness of the sludge blanket floating on the surface of a dissolved air floatation (DAF) unit can be increased by:
  - a. Decreasing the rate of recycle flow
  - b. Decreasing the speed of the surface sludge scrapers
  - c. Increasing the rate of recycle flow
  - d. Increasing the speed of the surface sludge scrapers
2. The watt is:
  - a. the basic unit of electrical power
  - b. the basic unit of electrical potential
  - c. the basic unit of electrical resistance
  - d. the basic unit of electrical current
3. The process called "nitrification" refers to:
  - a. the conversion of nitrogen gas to ammonia..
  - b. the conversion of nitrites to nitrates.
  - c. the conversion of ammonia to nitrates.
  - d. the conversion of nitrogen gas to nitrates.
4. What is the per capita flow into a treatment plant that receives an average of 2,250 gallons per minute for 24 hours from a community with 21,500 people?
  - a. 100 gpcpd
  - b. 110 gpcpd
  - c. 150 gpcpd
  - d. 180 gpcpd
5. The laboratory test used to measure the concentration of hydrogen ions in water is called
  - a. Turbidity
  - b. pH
  - c. Alkalinity
  - d. oxidation-reduction potential (ORP)
6. The ohm is:
  - a. the basic unit of electrical power
  - b. the basic unit of electrical potential
  - c. the basic unit of electrical resistance
  - d. the basic unit of electrical current
7. If too much aeration is provided in the aeration basin, what is most likely to happen in the secondary clarifier(s)?
  - a. the settling of the activated sludge will improve.
  - b. the oxygen uptake will increase.
  - c. the sludge will become bulky and hard to settle
  - d. there will be small floc particles on the surface of the clarifier
8. A wastewater treatment plant receives waste from domestic users and an industry. The influent flow is 850,000 and the influent BOD averages 775 mg/l. If an average of 0.17 lb./person/day is assumed for domestic waste, what is the population equivalent served by the plant
  - a. 12,537
  - b. 18,342
  - c. 24,157
  - d. 32,318

## Coliform Bacteria Regrowth

Coliform regrowth is the apparent regrowth of the indicator organisms (fecal coliform bacteria or *E. Coli* bacteria) used to determine if the effluent from wastewater treatment facilities has been properly disinfected. Samples taken from the end of the chlorine contact tanks at some wastewater treatment facilities and dechlorinated in the laboratory show few, if any, fecal coliform or *E. Coli* bacteria. Samples taken from the dechlorination tanks in the same facilities often show levels of bacteria that exceed the number allowed in those facilities' permits.

The problem was first noted at several of the 301(h) waiver primary treatment facilities serving towns in eastern Maine coastal communities. The problem was also documented at the Freeport, Maine secondary treatment plant. The problems at Freeport resulted in a consent agreement between the District and the DEP. The consent agreement required, in part, that the District study its disinfection system and participate in a stakeholder group with the DEP and the Department of Marine Resources. This stakeholder group was established to try to find the cause or causes of the regrowth problem and suggest possible solutions that would keep Freeport and other facilities from violating the bacteria limits in their permits.

Most of the research done on the regrowth of coliform bacteria has been done on drinking water systems. Virtually all of the studies researched pointed to the growth of a biofilm or "slime layer" on the surfaces of tanks, pipes and other containers carrying treated water. The normal method used by water utilities to treat or prevent the growth of the "slime layer" is to maintain chlorine levels in water distribution systems at or

near 2.0 mg/L. At this level, chlorine effectively prevents the growth of a slime layer. This concentration of chlorine, however, violates the best practicable treatment (BPT) standard of 1.0 mg/L established by the Department.

Some of the operators of primary treatment plants where regrowth has been a problem have noted that if the dechlorination tank gets "dirty", they begin to have problems with high fecal coliform bacteria counts in their effluent samples. This would seem to support the findings of the water treatment industry that a layer of "slime" can grow on tank walls and pipes and provide a place for fecal coliform bacteria to regrow.

There is also some evidence that some of the bacteria that test positive as fecal coliform bacteria are, in fact, naturally occurring soil bacteria of the genus *Klebsiella*. Fecal coliform limits are used only for discharges to estuaries or the ocean because the Department of Marine Resources (DMR), following nationally-established guidelines, uses fecal coliform as the indicator organism of potential bacterial contamination of shellfishing areas. Any bacteria found in the effluent from a wastewater treatment facility treating human waste that tests positive as fecal coliform bacteria must be assumed to have come from fecal material treated at that facility. Thus, even though the bacteria regrowing in the dechlorination tank at a wastewater treatment facility may be naturally-occurring soil bacteria, to protect human health and safety, we must assume that any bacteria testing positive as fecal coliform are fecal bacteria.

The stakeholder group looked most closely at the Freeport WWTF. The operators at Freeport did extensive studies of the chlorine and bacteria levels throughout their disinfection system. They found that

samples taken from the chlorine contact tank and dechlorinated in the laboratory had few, if any, fecal coliform bacteria present. Samples taken from the dechlorination tank and downstream of that tank showed significantly more fecal coliform bacteria. It should be noted that tests of the ambient water around the discharge of the Freeport WWTF done by the Department of Marine Resources have never shown fecal coliform bacteria in excess of allowable numbers. A number of samples split by the Freeport staff and analyzed by DMR laboratory staff showed fecal coliform levels less than the detection limit of the most probable number (MPN) method used by DMR.

The members of the stakeholder group also did research on fecal coliform regrowth in general and specific findings from wastewater treatment facilities in Maine. The group also investigated the relationship between bacteria permit limit violations, location of sampling point and the use of dechlorinating chemicals in the facility.

The stakeholder group made three recommendations to the management of the DEP Bureau of Land and Water Quality:

Recommendation 1: The MeDEP should establish a uniform location for fecal coliform sample collection. This should be in all permits issued by the MeDEP.

Recommendation 2: The MeDEP should modify chlorine discharge limits to allow facilities discharging to large rivers or the ocean to have higher limits so that dechlorination is not required. The BPT total residual chlorine (TRC) limits of 0.1 mg/L monthly average and 0.3 mg/L daily maximum should be eliminated in favor of water quality based limits for all facilities. Consideration should also be given to establishing mass limits rather than

concentration limits for chlorine.

Recommendation 3: The MeDEP should review the methods used to determine dilution ratios, especially for facilities discharging to the ocean.

Recommendation one is being implemented in all new MEPDES permits and for all other facilities through a letter from Brian Kavanah, in March 2003. This letter states that all effluent compliance monitoring samples must be taken "after the last treatment unit". The Department staff and management are discussing the remaining recommendations. In his letter, Brian Kavanah stated that operators of treatment facilities where sampling after the last treatment unit is impractical or a safety hazard should contact the Department so that other acceptable sampling arrangements could be found. The staff of at least one other facility has done their own study of bacteria regrowth and the Department staff will review the results of that study.

Operators of all treatment facilities using chlorine and a dechlorinating chemical are encouraged to clean the dechlorination tank and any accessible downstream piping on a regular basis to prevent the buildup of any slime layer. Further guidance and recommendations for operators will be made before the next disinfection season starts.

***Dick Darling***

### **Answers to *For Practice*:**

1. b. Decreasing the rate of the sludge scrapers will remove less of the sludge from the unit, making the sludge blanket thickness greater.
2. a. The watt is the basic unit used to measure electrical power.
3. c. Nitrification is the term for the complete conversion of ammonia to nitrates. Two groups of nitrifying bacteria are involved in this conversion. One group converts ammonia to nitrites and the second group converts the nitrites to nitrates.
4. c.  $2,250 \text{ gallons/min} \times 60 \text{ min/hr} \times 24 \text{ hr/day} = 3,240,000 \text{ gal/day}$   
 $3,240,000 \text{ gals/day} / 21,500 \text{ people} = 150 \text{ gallons/capita/day}$
5. b. pH measures the concentration of hydrogen ions in water. Neutral pH (pH = 7) means that there is a balance of hydrogen ( $\text{H}^+$ ) ions and hydroxide ( $\text{OH}^-$ ) ions in the water. When there are more hydrogen ions, the pH is lower. This is an acid condition. When there are more hydroxide ions, the pH is higher. This is an alkaline condition.
6. a. The ohm is the unit used to express electrical resistance.
7. c. Too much aeration will cause the sludge to become over-oxidized resulting in pin-floc formation. Pin floc do not settle well and will be carried up and over the weirs. Over-aeration may also cause well-formed floc particles to shear; breaking them into smaller clumps, which do not settle well.
8. d.  $850,000 \text{ gallons} = 0.85 \text{ MG}$   
Plant Loading =  $0.85 \text{ MG} \times 775 \text{ mg BOD/L} \times 8.34 \text{ lb./gallons} = 5494 \text{ lb. BOD/day}$   
 $5494 \text{ lb. BOD/day} / 0.17 \text{ lb./person/day} = 32,318 \text{ persons}$

### **Certification News**

The Fall Wastewater Treatment Plant Operator Exam will be given in the usual locations on November 12, 2003. Applications must be postmarked by September 27, 2003 or delivered to the DEP by September 29, 2003. If you need an application, contact Leslie Rucker at (207) 287-9031.